File Report – Justification for Sulfate Limit Applicable in High Quality Waters

Prepared for consideration in drafting surface coal mining General Permit

Assumptions:

Ohio EPA will continue to use of the existing GP for surface coal mining activities for a large area in 13 counties in southeastern Ohio (see Map 1). Records reveal that approximately 85% of all previously permitted surface coal mining projects occur in this area and the majority of abandoned mine land also overlaps this 13 county area. Water hardness in this area (non high quality water data set) was found to be higher than in the remainder of the coal bearing region of southeast Ohio. The existing permit was judged protective of water quality in this non high quality water region. See separate file report for additional information and analysis of results.

In reminder of southeast Ohio were some coal mining has and will likely continue we determined an increased likelihood of encountering either streams with high quality water designations or significantly lower water hardness values. In order to protect water quality in these areas a second GP with a sulfate limit is desirable. The following analysis was performed to establish that sulfate limit.

1) Ohio used the sulfate criteria equation recently developed by Illinois EPA in consultation with US EPA Region V as shown below. The Illinois sulfate criteria were approved by Region V on March 19, 2009 subject to completion of the Endangered Species Act consultation.

$$\text{Sulfate Criterion} = [-57.458+5.79(\text{hardness})+54.163(\text{chloride})]*0.65$$

The sulfate aquatic life water quality criteria are dependent upon water hardness and chloride levels present in the receiving water. As such, it is necessary to know these values in order to establish the numeric criterion and resulting permit limits to protect the aquatic life habitat use of the receiving water. Note that the operational range of the equation is for surface waters having a hardness of 100-500 mg/l and chloride level of 5 to less than 25 mg/l. Below a hardness of 100 mg/l, the sulfate criterion defaults to a value of 500 mg/l.

2) Ohio EPA conducted a retrieval of the LIMS database for chloride and water hardness ambient surface water data. LIMS is an electronic database used to store ambient

chemical data. Ohio EPA's EA3 database was also queried to provide station location information such as ecoregion, HUC12 watershed, county, etc. Information from the LIMS and EA3 databases were combined into a GIS application so that data could be sorted, analyzed, and visually displayed on maps. The data retrieval resulted in 17,073 raw data points. Of these, there were 8,617 records for chloride and 8,456 records for water hardness.

3) The period of record was for data collected between 9/3/1997 and 11/16/2010. This range of dates was used because this is the period of time for which data were available in the database at the time the data were retrieved.

4) The data retrieval was limited to those stream and river sites within the WAP (Western Allegheny Plateau) ecoregion, since the coal general permit activity primarily lies within the WAP ecoregion. This initial data screening step provided a data set that is more representative of the water quality conditions present within the geographical area to which the general permit will apply. At this stage of the analysis there was no attempt to limit or screen data based on drainage area, aquatic life use attainment status, type of aquatic life habitat use designation (warmwater habitat, exceptional warmwater habitat, limited resource water, modified warmwater habitat, coldwater habitat, limited warmwater habitat) or proximity to either point or nonpoint pollution sources. See later steps for descriptions of what data was screened based upon aquatic life use designations and antidegradation classifications.

5) The central tendency of the chloride data and central tendency of the hardness data was computed for each site. The computation process used to determine the central tendency for each site was dependent on the quantity of available data. The arithmetic mean was used for sites having fewer than ten sample results while the median was used for sites having ten or more sample results. Non-detect values were included in the analysis using a value equal to one-half the detection limit. These procedures are routinely used by the Division of Surface Water to analyze water quality data (see OAC Chapter 3745-2). This resulted in average water hardness data for 1,114 sites and average chloride data for 1,123 sites.

6) Sites within the WAP ecoregion but not located within Ohio's coal bearing region were excluded from further analysis in an effort to further refine the data to the water quality conditions and geographical portion of the state to which the coal general permit will apply. This reduced the number of sites to 758 for chloride and 740 for water hardness.

7) Sites were then subdivided into two groups: high quality water and non high quality water groups. The first group was composed of sites lying within watersheds (HUC12) that contain one or streams designated as exceptional warmwater habitats, coldwater habitats, outstanding state waters and superior high quality waters. This "high quality group" was composed of 210 sites.

8) An additional 79 sites were added to the high quality water data set to capture an area lacking the higher designated stream uses but displaying comparatively very low water hardness (many values below 100 mg/l compared to typical values above 200 mg/l). These sites from Gallia, Jackson, Lawrence and Scioto counites were pre-screened to eliminate streams designated Limited Resource Waters (14 sites) plus 3 other highly impacted sites.

9) The 25th percentiles of the average water hardness and chloride data from the 289 sites in the combined "high quality/low water hardness group" were calculated to establish the values that were used in the sulfate water quality criteria equation. Use of the 25th percentile was based on paragraph (E)(1)(b) of rule 3745-2-04 of administrative code. The 25th percentile was 8.2 mg/l for chloride and was 99.9 mg/l for water hardness. At water hardnesss values below 100 mg/l the sulfate criteria defaults to a value of 500 mg/l.

10) The resulting sulfate criterion of 500 mg / applies as the surface coal mining GP sulfate limit in the following areas (see Map):

(See list of counties and watershed on separate document)